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ABSTRACT

Regardless of ambiguous feelings about using microcomputers in schools, it is likely that education will remain substantially the same with their widespread use. The microcomputer will modify the way some skills are taught, but the need to teach the skills will remain. Most contemporary critiques of using microcomputers in the classroom are directed at the behaviorist model of learning used in preparing computer-based learning materials for children. Certainly, influences of behavioristic practices are ingrained in the uses of microcomputers in the classroom and behaviorist theory is evident in the development of computer-assisted instruction. Much of the criticism, though, is trivial and misses the point of using computers in classrooms. For the teacher, the real question to ask is "What is discoverable and what is better taught." Teachers also have the problem of determining how and when to intervene. Generally, problem solving and microcomputers go together. Wise men, women, and children will harness the use of the computer for a quite different future world and life style. Seventeen pages of references conclude the document.) (RH)

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ABSTRACT

With the Microcomputer, Behaviorism Returns to Early Childhood Education

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One promise that the microcomputer has in its potential to be interactive. The microcomputer will modify how we teach a skill, but the need to teach the skill remains. For children to learn the concepts in LOGO of FORWARD (FD), RIGHT (RT), LEFT (HT), so many spaces, they have to get out from behind their computers and march around forward, right and left as though they were the turtle. Children learn in many ways; psychological models of how children learn, be they behavioristic, cognitive, developmental, or sociopsychological are only metatheories. Using the Computer-Assisted Instruction, CAI mode, children efficiently learn specific information and skills. Behaviorist theory is a major theoretical base in the development of CAI materials: 1) learn one small skill at a time, 2) reward the learner for success, 3) order skills in a hierarchy of abstraction. Cognitive theory also influences CAI materials development: 1) structure of learning derived from contact, 2) readiness for learning depends on the structure of the content, 3) intuitive learning is an analytic process, 4) motivation is derived from the content structure, not the medium, and 5) aides to learning should allow the learner to expand the grasp of the subject matter. Even in early childhood, not all children are ready for computers; however, the computer can help children become efficient problem solvers.

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With the Microcomputer, Behaviorism Returns to Early Childhood Education

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The current media slogan for creating a need for microcomputer is: "Spend (not save) for your child's education. Buy a __ microcomputer."

This need is created by a behaviorist procedure which threatens that children will not succeed in school without a micrcomputer at home. The parent who makes the investment will be rewarded by having a successful, bright child in school. Troubled parents have called me to ask if they should not pull their children out of elementary schools where there are no computers in use in the classroom.

As a result of this media pressure, parents display ambiguous attitudes about computers, learning, and interaction with their children. The media says buy and use computers, the child psychologists say spend time with children in playing, discovering, and enjoying life; discuss ideas and share books with your children. Teachers can also be ambiguous about computers. They know that computers in their classrooms will change not only how they teach but what they teach. Teachers also know that they will have to learn how to use computers. Only the most naive person would consider the computer to be a toy. High technology is as intricate as its circuitry and takes long, painful hours to master. Yet, microcomputers are fashionable in the classroom and everyone appreciates and longs to be decked in high fashion.

If the past is any clue to the future, we can assume that in public and private education, the more things change, the more they stay the same. If over the past three decades, the wonderful media of television did not alter education, it is not likely that computers will either. The one promise that the microcomputer has is its potential to be interactive. But TV also has that potential. When my local PBS channel needs money, they have a drive for money on the screen. They tell me to call in $50 and I do just that.

The microcomputer will modify how we teach some educational skills, but the need to teach the skills is always there. My memory tells me that learning the multiplication tables was painful until I could apply what I had committed to rote memory in interesting algebraic and logical procedures. For children to learn the concepts in LOGO of FORWARD (FD), RIGHT (RT), LEFT (LT) so many spaces, they have to get out from behind their computers and march around forward, right and left as though they were the turtle. The children have to perceive that a teacher command such as "erase the

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blackboard" is similar in LOGO to CLEARSCREAN (SC). Also there is a notion that when the pin is down, PENDOWN (PD), on a piece of paper and the paper or the pen moves, a mark will be made. If the pen is up, PENUP(PU), there will be no mark on the page, children learn to use information and new concepts by applying them to or building on what they already know.

Educators must also realize that children learn in many ways, and that the psychologist's description of how this learning takes place is only metapsychology, language about how children learn, not really how children learn. The terms which describe learning theory models, behaviorist, cognitive, developmental, psychosocial do not explain how learning takes place but are only the names of theoretical models of learning.

All of the learning theory models are flawed by gaps in the theory. Most of the contemporary critiques of using the microcomputers in the classroom point a finger at the behaviorist model of learning in preparing computer-based learning materials for children: "The computer is nothing but a page turner." "All that the children do is press the RETURN button." "The rewards are inane." "There's no research showing that CAI is better than traditional teaching." All of these criticisms are trivial and miss the point of using computers in the classroom. The "page turner" complaint misses the concept that each new page is really a different learning frame. The RETURN button complaint is an authoring and programming problem. Children can enter numbers, words, sentences, and pictures. The research question asks the wrong question. From research done in the late 1960's and early 1970's we do know that children will learn as much specific content from a given knowledge text or book as they do from an equivalent knowledge based CAI program. However, they do learn the specific information significantly more quickly on the CAI program and they have a better attitude toward the CAI program (Caldwell, 1973). It is now time to ask more useful research questions: Do children who spend long hours on the computer learn to read as well as those who spend similar amounts of time in reading instruction? Can special education children profit by using the computer? Is there a pattern or scheme to children's debugging procedures? What mathematics and reading skills are pupils learning with LOGO? What skills learned at the computer can be transferred to life and classroom experiences? What programming and CAI ideas and projects will engage children?

Behaviorist theory comes through loud and clear in the development of computer-assisted instruction: 1) learn one small skill at a time, 2) reward the learner when skill is learned, 3) order skills in an easy to difficult hierarchy. But we must also remember that Bruner's (1960) ideas also influenced authors of CAI materials: 1) the structure of learning is to be derived from the content, 2) readiness for learning depends on the structure of the content, 3) intuitive learning is based on an analytic process, 4) motivation for learning is derived from the structure, 5) aides to teaching should allow the learner to expand the grasp of the subject

matter. Computer-assisted instruction, CAI, cannot be all bad. Since its initial inception CAI has grown to include simulation, gaming, graphics and has been used to teach some very complicated concepts and skills including computer programming and computer manufacturing procedures.

Tutorial CAI finds its greatest application in teaching clearly delimited subject matter. An example of this for children is to teach computer keyboarding using CAI methodology. For those of us who work with children at the computer, it soon becomes apparent that to utilize the CAI mode to its maximum, the child must develop keyboarding skills, certainly by the third grade this skill should be taught using CAI methodology. In teaching vocabulary using CAI, the child should learn to say, spell, and use the word in concrete examples rather than by rote definitions. In teaching grammar, the child must be able to translate a concept such as the uses and terms of the plural morpheme into being able to change a singular sentence into the plural form. CAI can be a fresh start in teaching concepts and skills simultaneously.

CAI is usually used for clearly delineated subject matter, so that only one choice in the multiple choice format is acceptable. However, answers to many questions are neither all right or all wrong. Children on a CAI program will frequently perceive and answer a question differently from the expectations of the author. In such a case the teacher should be nearby to receive a child's expressed thoughts which are energized by the computer program.

Subject material such as the interpretation of a poem might be left to classroom discussion, but the actual production of a poem might be handled on the computer by using highly structured forms such as Haiku or the Diamante, or even a probing word-processing program such as the Bank Street Writer, if it had a promptor system.

Not all children come to school with the same potential for learning. Students with special needs cannot profit from traditional instructional methodology without hiring more tutors, a dubious practice in times of scarce funds and given what we know about the lack of efficacy of tutorial practices.

There are other influences of behavioristic practices ingrained in the uses of microcomputers in the classroom. Keyboarding for young children is critical and of course they are rewarded for accuracy and speed in a game-like fashion. Once keyboarding is learned, and even before, primary grade children can learn to write and read simultaneously, particularly if there is a voice synthesizer attached as a peripheral to the computer. Children hear a phoneme repeated by the computer lady or man (voice synthesizer), a letter or letters appears on the screen and the child, ages three to five, types the letter. The child soon learns the forty-two phonemes and keys to represent those phonemes. The child is then able to write anything that he or she can say. The spelling is nonstandard and represents the child's dialect, but with imagination, any adult can read the child's written message.

Writing Your Ideas is a CAI program developed for intermediate grade children. Each lesson contains a sequence of modules in which the child learns to generate sentences according to linguistic structure patterns. By the end of the lesson, the child can reconstruct a narrative with the previously generated sentences. Although fourth, fifth, and sixth graders could go through the program, the sixth graders went through the materials most quickly and efficiently and interacted with themselves and the teacher as they progressed through the program.

LOGO offers some interesting behavioristic methodology for children. The key word in teaching young children how to program in LOGO is anthropomorphization. The child has to learn to talk to the turtle and the computer. For example, the notion of teaching the computer to do something is TO. In order to play turtle or teach the turtle the child has to walk a square or a circle and to verbalize the procedure in turtle language. The child's and the turtle's state is changed with each command or movement. Playing turtle can be compared to calling moves at a square dance. Debugging is not unique to the computer world. We make wrong turns all of the time in real life. Wrong turns provide a bug collection. Bugs and debugging are a part of life. If we do not like the bug (turn) we can debug. In real life debugging our wrong turns is sometimes more difficult than debugging a computer program.

For the teacher, the real question to ask is what is discoverable and what is better taught. After teaching some simple geometric figures such as TO SQUARE, TO RECTANGLE, TO TRIANGLE, it might be possible for a child to learn TO HOUSE. Third graders we have seen in inner city, New York schools have been able to develop these kinds of programs. Teachers also have the problem of how and when to intervene. Frequently, as we have observed, peers in the classroom are better teachers than the teacher. The problem of defining the curriculum, what are childrer cognitively learning, are children learning to read and learning math concepts while spending long hours in LOGO, and how do special education children respond to LOGO in comparison to regular students remain viable research questions.

In this discussion we should consider early childhood education, microcomputers and behaviorism in the child's future world. In my experience, I have watched children at the computer at what is basically a benavioristic task or program and then to verbalize a quite profound intuitive or cognitive statement. Neither the microcomputer nor a behavioristic learning experience seem to be harmful to the child. What about such nasty behaviors such as anthropomorphization and violence in the program or the game. These two phenomenon seem to appear naturally in the child's world. Children talk to their stuffed animals and when they play, can destroy them. In very young children's writing, violent themes occur without an ounce of remorse and Grimm's Fairy Tales are anything but nonviolent.

Are all young children ready for computers? The answer, of course, is "no." If a child turns away from the computer in favor of another activity, the child is showing nonreadiness. Accept the hint. Even in early childhood some children will be people oriented and others will be object oriented, others will function equally well with both people and objects.

Problem solving and microcomputers go together. If a child can learn to program LOGO and then go from LOGO to BASIC and from there to PASCAL or some other higher level computer language, the child will have made enormous strides towards living in a high tech world rather than a clock-work orange world. Both natural language and computer language are computational as well as creative ways of expression and problem solving. Wise men, women, and children will harness the use of the computer for a quite different future world and life style.

REFERENCES

Are computers hazardous to your child's health.(1981, May). Personal Computing, 5(5), 34-35.95.

Behrmann, Mike, Lahm, Liz. (1983). Critical learning: Multiple handicapped babies get on-line. Paper presented at the Council for Exceptional Children National Conference on the Use of Microcomputers in Special Education , March 10-12, 1983. Hartford, CT. (ERIC Document Reproduction Service No. ED 232-330).

Bender, Martin L. A voluntary prekindergarten language development and reading program for the entire four-year-old population of a city (an investigation of machine-taught reading). Final report. (ERIC Document Reproduction Service No. ED 020-855).

Bessent, E. Wailand, and others. (1974). Problem manual for instructional decision-making module; 2: A computer assisted instruction manual.Document No. 4. Texas Education Agency, Texas Univ. Austin. (ERIC Document Reproduction Service No. ED 121-029).

Bessent, E. Wailand, and others. (1974). Student manual for instruction decision-making module; 1: A computer assisted instruction module. Document No. 3. Texas Education Education Agency. Texas Univ. Austin. (ERIC Document Reproduction Service No. ED 121-028).

Bibliography of materials published about the Edison responsive learning system; The "talking typewriter."(1969, Sept.). Responsive Environment Corp. New York, NY. (ERIC Document Reproduction Service No. ED 028-648).

Bowman, Barbara T. Do computers have a place in preschools. Paper presented at the meeting of the New Mexico Assocation for the Education of Young Children. (1983, Feb. 25). Albuquerque, NM. (ERIC Document Reproduction Service No. ED 231-1504).

Bruner, Jerome S. (1960). The process of education. New York: Vintage Books.

Building foundations for educational change: Wisconsin Title III ESEA.(1975). Wisconsin State Dept. of Public Instruction. Madison, Wisc. (ERIC Document Reproduction Service No. ED 110-573).

Butler, Cornelius E. (1969). Gambits, educational innovations in San Mateo County. San Mateo County PACE Center, Redwood City, Calif. (ERIC Document Reproduction Service No. ED 020-260).

Cable tv: The electronic school-house. (1976, April). Audio-Visual Communications. 10, (4), 28-29.

Caldwell, R. M. (1973). A comparison of a programmed text and a computer based display unit to teach reading skills to semi-literate adolescents. Unpublished Ph.D. Dissertation. The Pennsylvania State University.

Cartwright, Carol A., & others. (1972, Feb.) CAI course in the early identification of handicapped children. Exceptional Children, 38 (6), 453-9.

Cartwright, G. Phillip, & Cartwright, Carol A. (1973). Early identification of handicapped children: A CAI course. Journal of Teacher Education, 24 (2), 128-34, Summer 1973.

Cartwright, G. Phillip, & Cartwright, Carol A. (1972) Early identification of handicapped children. (Computer Assisted Remedial Education Report No. R-36). University Park, PA: Pennsylvania State University, Computer-Assisted Instruction (ERIC Document Reproduction Service No. ED 077 165)

Chiang, Alice, & others. (1978). Demonstration of the use of computer-assisted instruction with handicapped children. (Final Report). Arlington, VA: RMC Research Corp. (ERIC Document Reproduction Service No. ED 166 913)

Cogen, Victor. (1969, Aug.) The computer's role in education and use with the exceptional child. Mental Retardation, 7 (4), 38-41.

Colby, Kenneth Mark. (1973, Jul.-Sep.). The rationale for computer-based treatment of language difficulties in nonspeaking autistic children. Journal of Autism and Childhood Schizophrenia, 3 (3), 254-60.

Computers expand education--across the country and around the clock. (1975, Sep.). Modern Schools, 8-11.

Computer-assisted instruction in education of the migrant Mexican American. (1968). Austin, TX: Southwest Educational Development Lab. (ERIC Document Reproduction Service No. ED 080 243)

Computer assisted planning: A user manual for computer based resource units. (1972). Buffalo, NY: State University of New York. Educational Research and Development Complex. (ERIC Document Reproduction Service No. ED 073 587)

Cook, John. (1982). Children, information and new technologies. Paper presented at the Annual Conference of the Library Association of Australia (Adelaide, South Australia), August 22-26, 1982. (ERIC Document Reproduction Service No. ED 226 706)

Daniels, Alan. (1971). Young--must learn to talk to computers. Times (London) Educational Supplement, 2939 (42), September 17, 1971.

Day, Harvey, & Parnes, Robert. (1975). A computer based simulation as an alternative teacher training strategy. Paper presented at the Annual Meeting of the American Educational Research Association, Washington, D.C. March 30 - April 3, 1975.

Dimick, Barbara. (1983, Spr.). The microcomputer in the public library: A children's room experience. Top of the News, 39 (3), 253-59.

Dirr, Peter J. (1975, Sept.). The age of technology: A bibliography. (ERIC Document Reproduction Service No. ED 105-679).

Dirr, Peter J. (1975, Sept.). Individual instruction: A bibliography. (ERIC Document Reproduction Service No. ED 105-678).

Dirr, Peter J. (1975, Sept.). Practical application of media: A bibliography. (ERIC Document Reproduction Service No. ED 105-660).

Dupuis, Mary M. (1974). We care about in-service education. Paper presented at the Annual Meeting of the International Reading Association (19th, New Orleans, May 1-4, 1974).

Dusewicz, Russell A. (1981, Fall). Technology in the education of young children. Journal of Children in Contemporary Society, 14(1), 13-14.

Dykstra, Ralph R. (1973, November). Outdoor education for the handicapped. Proceedings from Special Study Institute. Buffalo, NY: State University of New York. (ERIC Document Reproduction Service No. ED 105 672)

Feldman, David H., & Sears, Pauline S. (1970, March). Effects of computer assisted instruction on children's behavior. Educational Technology, 10 (3), 11-14.

Fletcher, John D. (1974, April). Computer-assisted instruction for the deaf. Paper presented at the American Educational Research Association Annual Meeting, Chicago, IL.

Fletcher, John D, & others. (1973). Computer-assisted instruction for the deaf at Stanford University. (Annual Report). Stanford University California Institute for Mathematical Studies in Social Science. (ERIC Document Reproduction Service No. ED 072 641)

Fletcher, J. D., & Beard, M. H. (1973). Computer-assisted instruction in language arts for hearing-impaired students. (Tech. Rep. No. 215). Stanford University California Institute for Mathematical Studies in Social Science. (ERIC Document Reproduction Service No. ED 095 857)

Fletcher, J.D., & Suppes, Patrick. (1973). Computer-assisted instruction in mathematics and language arts for the deaf. (Final Report). Stanford University California Institute for Mathematical Studies in Social Science. (ERIC Document Reproduction Service No. ED 084 871)

Galbraith, Gary, & others. (1979, September). Interfacing an inexpensive home computer to the videodisc: Educational applications for the hearing impaired. American Annals of the Deaf, (Educational Technology for the '80's), 124 (5), 536-41.

Green, Donald Ross, & others. (1968, April). Learning to recognize words and letters on a CAI terminal. Paper presented at International Reading Association conference, Boston, MA. (ERIC Document Reproduction Service No. ED 027 177)

Guidelines for developing computer based resource units. (1972). State University of New York, Buffalo. Educational Research and Development Complex. (ERIC Document Reproduction Service No. Ed 073 586)

Hall, Keith A. (1974, July). CARE: Computer assisted renewal education. Viewpoints, 50 (4), 65-79.

Hall, Keith A. (1974, May). CARE: Computer assisted renewal education. Paper presented at the Shared Educational Computer Systems (SECOS) Conference, New Paltz, NY. (ERIC Document Reproduction Service No. ED 097 903)

Hamada-Adler, Renee, & White, Mary Alice. (1982). Differences between children and adults in learning BASIC on microcomputers. Columbia University Teachers College, New York, NY. (ERIC Document Reproduction Service No. Ed 225 643)

Hankin, Edward K., & others. (1966). The development of pre-vocational educational literacy courses for use with computer assisted instruction of disadvantaged youth and adults. (Tech. Prog. Rep.). Florida State University, Tallahassee. (ERIC Document Reproduction Service No. ED 015 230)

Hansen, Duncan N., & others. (1972). Computer applications laboratory (Computer-assisted instruction center). (Annual Prog. Rep.). Florida State University, Tallahassee. (ERIC Document Reproduction Service No. Ed 081 214)

Harris, Larry A. (Comp.). (1968). Title III (PACE) projects on reading. ERIC/CRIER Reading Review Series, 2 (16). Indiana University, Bloomington. (ERIC Document Reproduction Service No. ED 029 162)

Harvie, Barbara, & Anton, Julie. (1983, Spring). Is there a microcomputer in your future? ComputerTown thinks the answer is "Yes". Top of the News, 39 (3), 275-81.

Harvie, Barbara. (1981, November). Out of the arcades and into the library. American Libraries, 12 (10), 602-05.

Herron, R.E., & Frobish, M. J. (1969, August). Computer analysis and display of movement patterns. Journal of Experimental Child Psychology, 8 (1), 40-44.

Hickok, Treacy A. (1975, August). Computer education for deaf youngsters: A mutual effort by the University of California and the California School for the Deaf in Berkeley. A paper presented at the Association for the Development of Computer-Based Instructional Systems Summer Meeting, Portland, ME. (ERIC Document Reproduction Service No. Ed 111 439)

Hines, Theodore C., & others. (1980, Winter). The children's media data bank. Top of the News, 36 (2), 176-80.

Holland, James G. (1971, March). The use of a computer for programmed instruction presentation of a pre-school classification program. Paper presented at the AERA Conference, New York, NY. (ERIC Document Reproduction Service No. ED 056 510)

Holzman, Thomas G., & Glaser, Robert. (1977, August). Developing computer literacy in children: Some observations and suggestions. Educational Technology, 17 (8), 5-11.

Hudson, Walter W. (1971, May). An autotelic teaching experiment with ancillary casework services. American Educational Research Journal, 8 (3), 467-83.

Knutson, Jack M., & Prochnow, Robert R. (1970). Computer assisted instruction for vocational rehabilitation of the mentally retarded. Texas University College of Education, Austin. (ERIC Document Reproduction Service No. Ed 044 039)

Lake, Thomas P. (Ed.). (1974). Manpower development exemplary programs for the handicapped. Council for Exceptional Children, Reston, VA. (ERIC Document Reproduction Service No. ED 090 742)

Library services to gifted youth. (1982, Summer). Top of the News, 38 (4), 301-44.

Lieberman, Henry. (1976, June). The TV turtle: A LOGO graphics system for raster displays. (AI memo 361). Massachusetts Institute of Technology, Artificial Intelligence Lab, Cambridge. (ERIC Document Reproduction Service No. ED 207 577)

Long, Sandra M. (1982, May). Transforming our society. Instructional Innovator, 27 (5), 14-16.

Lowery, Bennie R., & Knirk, Frederick G. (1982-83). Micro-computer video games and spatial visualization acquisition. Journal of Educational Technology Systems, 11 (2), 155-66.

Lutz, Kathy A. (1973). Multimode knowledge of results in PLATO courseware. Computer-based Education Research Lab, University of Illinois, Urbana. (ERIC Document Reproduction Service No. ED 124 139)

Luyben, Paul D. (1973). The effects of pictures on the acquisition of a sight vocabulary in rural EMR children. Paper presented at the American Educational Research Association Annual Meeting, New Orleans, LA. (ERIC Document Reproduction Service No. ED 074 752)

Martin, John H. (1964). Freeport public schools experiment on early reading using the Edison Responsive Environment Instrument. Responsive Environment Corporation, New York, NY. (ERIC Document Reproduction Service No. ED 002 586)

Murphy, Harry J. (1971, Summer). The impact of technology in a school for the deaf. Hearing and Speech News, 39 (4), 20-22.

Naro, Jean N. (1976, December). Innovation in teacher training: A conversation with Melvyn I. Semmel. Education and Training of the Mentally Retarded, 11 (4), 353-60.

Nelon, Edwina M. (1972). An evaluation of computer assisted vocabulary instruction with mentally retarded children. (Research Report No. 7322). Syracuse City School District, NY. (ERIC Document Reproduction Service No. ED 090 964)

Nelson, Harold. (1981, Summer). Learning with LOGO. On Computing, 3 (1), 14-16.

New technology in education: Selected references. (1971). Congress of the U.S. Washington, D.C: House Committee on Science and Astronautics. (ERIC Document Reproduction Service No. ED 056 486)

Nickerson, Raymond S., & others. (1974). Draft curriculum manual: A review of speech problems of the deaf and a preliminary guide to use of the BBN system of speech-training aids. (Report No. 2911). Bolt, Beranek, and Newman, Inc., Cambridge, MA. (ERIC Document Reproduction Service No. ED 100 356)

Nickerson, Raymond S., & Stevens, Kenneth N. (1974). Development of computerized speech-training aids for deaf. (Report No. 2914 Final Report). Bolt, Beranek, and Newman, Inc., Cambridge, MA. (ERIC Document Reproduction Service No. ED 100 357)

Nickerson, Raymond S., & others. (1974). A computer-based system of speech-training aids for the deaf: A progress report. Bolt, Beranek, and Newman, Inc., Cambridge, MA. (ERIC Document Reproduction Service No. ED 100 353)

Nix, Don. (1978, March). Project straight-talk. Paper presented at the Annual Meeting of the Association for the Development of Computer-Based Instructional Systems, Dallas, TX. (ERIC Document Reproduction Service No. ED 161 422)

Nocerino, Joseph T., & others. (1978, Summer). Interactive television: A pathway to futures in special education using telecommunication. Paper presented at the World Congress on Future Special Education, First, Stirling, Scotland. (ERIC Document Reproduction Service No. ED 157 334)

Palmer, David D., & others. (1971). Computer assisted remedial education: Early identification of handicapped children. (Course planning manual). Pennsylvania State University, University Park. (ERIC Document Reproduction Service No. ED 076 049)

Perlman, Radia. (1976). Using computer technology to provide a creative learning environment for preschool children. (Al Memo 360). Massachusetts Institute of Technology, Cambridge. (ERIC Document Reproduction Service No. ED 207 576)

Piestrup, Ann McCormick. (1981). Preschool children use Apple II to test reading skills programs. Advanced Learning Technology, Portola Valley, CA. (ERIC Document Reproduction Service No. ED 202 476)

Piestrup, Ann M. (1982). Young children use computer graphics. Harvard University, Cambridge, MA. (ERIC Document Reproduction Service No. ED 224 564)

Prinz, Philip M., & others. (1982, September). Early reading in young deaf children using microcomputer technology. American Annals of the Deaf, 127 (5), 529-35.

Proceedings of the conference on instructional methods and teacher behavior. (1966, November). Far West Lab for Educational Research and Development, Berkeley, CA. (ERIC Document Research Service No. ED 016 390)

Research and evaluation of computer-based resource units. (1972). State University of New York, Buffalo. (ERIC Document Reproduction Service No. ED 073 589)

Research on computer based resource units. (1970, March). A compendium of papers presented to the American Educational Research Association. (ERIC Document Reproduction Service No. ED 093 130)

The research unit handbook. (1976). Bristol University, England. (ERIC Document Reproduction Service No. ED 120 138)

Rieth, Herbert J., & Semmel, Melvyn I. (1979, Winter). The used of microcomputer technology to prepare and to enable teachers to meet the educational needs of handicapped children. Teacher Education and Special Education, 2(2), 56-60.

Rothenberg, Donna, & Morgan, Robert P. (1976, Feb.). Case studies of innovation in the educational service sector. St. Louis, MO: Washington Univ. Center for Development Technology. (ERIC Document Reproduction Service No. ED 112 941).

Sample computer based resource guide for world health. (1972). State University of New York, Buffalo. Educational Research and Development Center. (ERIC Document Reproduction Service No. ED 073 588)

Sandals, Lauran H. (1975, September). Computer assisted learning for the future: Some practical considerations for research, especially with children and adolescents who have handicaps and/or learning problems. Programmed Learning and Educational Technology, 12 (5), 299-305.

Sandals, Lauran H. (1979). Computer assisted applications for learning with special needs children. Paper presented at the Meeting of the American Educational Research Association. (ERIC Document Reproduction Service No. ED 173 983)

Saracho, Olivia N. (1981). Planning computer assisted instruction for Spanish-speaking migrant students. Journal of Educational Technology Systems, 10 (3), 257-60.

Saracho, Olivia N. (1982, Summer). The effects of a computer-assisted instruction program on basic skills achievement and attitudes toward instruction of Spanish-speaking migrant children. American Educational Research Journal, 19 (2), 201-19.

Searle, Barbara W., & others. (1973). Structural variables affecting CAI performance on arithmetic word problems of disadvantaged and deaf students. Stanford University California Institute for Mathematical Studies in Social Science. (ERIC Document Reproduction Service No. ED 084 158)

Searles, John E. (1981, Fall). Impact of computer technology on the child in a narcissistic culture. Journal of Children in Contemporary Society, 14 (1), 89-96.

Sedlak, Robert A., & others. (1972, Nov/Dec). Using student attitudes as an index for gauging improvements following a formative evaluation. College Student Journal, 6 (4), 3-9.

Semmel, Melvyn I., & others. (1976). The effects of CATTS' feedback in a preservice special education teacher training program. (Final Report). Center for Innovation in Teaching the Handicappped, Indiana University, Bloomington. (ERIC Document Reproduction Service No. ED 162 466)

Semmel, Melvyn I., & others. (1976). The effectiveness of a computer-assisted teacher training system (CATTS) in the development of reading and listening comprehension instructional strategies of preservice special education trainees in a tutorial classroom setting. (Final Report). Center for Innovation in Teaching the Handicapped, Indiana University, Bloomington. (ERIC Document Reproduction Service No. ED 162 467)

Semmel, Melvyn I., & others. (1976). The development of oral reading prompting skills in the CATTS-CBTE program for preservice teachers of the mildly handicapped. (Final Report). Center for Innovation in Teaching the Handicapped, Indiana University, Bloomington. (ERIC Document Reproduction Service No. ED 162 468)

Semmel, Melvyn I., & others. (1976). The improvement of social status among rejected pupils through the modification of teacher behavior using the computer-assisted teacher training system (CATTS): An inservice training application of CATTS. (Final Report). Center for Innovation in Teaching the Handicapped, Indiana University, Bloomington. (ERIC Document Reproduction Service No. ED 162 469)

Semmel, Melvyn I., & Olson, Jerry. (1977). System documentation manual. Center for Innovation in Teaching the Handicapped, Indiana University, Bloomington. (ERIC Document Reproduction Service No. ED 162 465)

Sewell, D.F., & others. (1980, January). Language and the deaf: An interactive microcomputer-based approach. British Journal of Educational Technology, 11 (1), 57-68.

Siegfried, Pat. (1983, Spring). Computers and children: Problems and possibilities. Top of the News, 39 (3), 241-46.

Silverman, Charles. (Ed.). The high/scope report. Number four. High/Scope Educational Research Foundation, Ypsilanti, MI. (ERIC Document Reproduction Service No. ED 176 856)

Smithy-Willis, Deborah, & others. (1982, Nov/Dec). Visual discrimination and preschoolers. Educational Computer, 2 (6), 19, 45.

Snelbecker, Glenn E. (1981, Fall). Impact of computers and electronic technology on the teaching methodologies and the learning process. Journal of Children in Contemporary Society, 14 (1), 43-53.

Soeffing, Marylane. (1975, March). Where the action is: A look at four special education R and D centers. Exceptional Children, 41 (6), 419-25.

Solomon, Cynthia J., & Papert, Seymour. (1976). A case study of a young child doing turtle graphics in LOGO. (Al Memo 375). Artificial Intelligence Lab, Massachusetts Institute of Technology, Cambridge. (ERIC Document Reproduction Service No. ED 207 578)

Solomon, Cynthia J. (1975). Leading a child to a computer culture. (Al Memo 343). Artificial Intelligence Lab, Massachusetts Institute of Technology, Cambridge. (ERIC Document Reproduction Service No. ED 207 575)

Spencer, Mima, & Baskin, Linda. (1983). Microcomputers in early childhood education. ERIC Clearinghouse on Elementary and Early Childhood Education, Urbana, IL. (ERIC Document Reproduction Service No. ED 227 967)

Steinberg, Esther R. (1980, July). Evaluation processes in young children's problem solving. Contemporary Educational Psychology, 5 (3), 276-81.

Suppes, P., & others. (1973). Models of individual trajectories computer-assisted instruction for deaf students. (Technical Report No. 214). Stanford University California Institute for Mathematical Studies in Social Science. (ERIC Document Reproduction Service No. ED 094 771)

Suppes, Patrick, & Fletcher, John Dexler. (1974). Computer-assisted instruction in mathematics and language arts for deaf students. Stanford University California Institute for Mathematical Studies in Social Science. (ERIC Document Reproduction Service No. ED 093 365)

Tait, K., & others. (1973, June). Feedback procedures in computer-assisted arithmetic instruction. British Journal of Educational Psychology, 43 (pt 2), 161-71.

Tickton, Sidney G. (Ed.). (1970). To improve learning: An evaluation of instructional technology. Volume I. Part One. A report by the Commission on Instructional Technology. Part Two; Instructional Technology; Selected working papers on "The State of the Art". R.R. Bowker Company, New York, NY.

Tursman, Cindy. (1982, November). Powerful ideas. Educational Leadership, 40 (2), 68-70.

Verbesey, J. Robert. (1983, June). Public microcomputers on Long Island. Library Journal, 108 (12), 1211-13.

Villbock, Mary Ann, & others. (1971). Computer assisted remedial education: Early identification of handicapped children. Syllabus. Computer-assisted Instruction Lab, Pennsylvania State University, University Park. (ERIC Document Reproduction Service No. ED 076 050)

Vitello, Stanley J., & others. (1972). Follow-up evaluation of a computer assisted instruction course on the early identification of handicapped children. (ERIC Document Reproduction Service No. ED 077 868)

Walker, Nancy. (1971, Nov-Dec). This teacher's a machine. Reading Newsreport. 6 (2), 33-34.

Wallach, Michael A. (1966). Creativity and the expression of possibilities. (ERIC Document Reproduction Service No. ED 031 523).

Watt, Dan. (1983, Sept.). Games designed for learning. Popular Computing, 2 (9), 65-67.

Watt, Dan. (1983, March). Informal learning. Popular Computing 2 (5), 60, 62-64.

Watt, Dan. (1982, July). Teaching turtles: LOGO as an environment for learning. Popular Computing, 1 (9), 48, 50, 52, 54, 56.

Wegmann, Robert G. (1980). Educational challenges of the 1980's. U.S. District of Columbia. (ERIC Document Reproduction Service No. ED 194 476)

Wertz, Florence C. (1983, March). Teaching blissymbols with the aid of the Apple II computer. Paper presented at the Council for Exceptional Children National Conference on the Use of Microcomputers in Special Education. Hartford, CT., March 10-12, 1983. (ERIC Document Reproduction Service No. ED 231 096)

Weyer S.A., Cannara, A.B. (1975). Children learning computer programming: experiments with languages. (Technical Report No. 250). Washington, D.C.: National Science Foundation. (ERIC Document Reproduction Service No. ED 111 347)

Wrege, Rachael. (1982, June). Hands on? Popular Computing, 1 (8), 110-23.

Zeiser, Edward L, & Hoffman, Stevie. (1983, March-April). Computers: Tools for thinking. Childhood Education, 59 (4), 241-54

Ziajka, Alan. (1983, July). Microcomputers in early childhood education. Young Children, 38 (5), 61-67.